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Analysis of Student's Mathematical Literacy Ability on Linear Program Material Reviewed From Cognitive Styles

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ABSTRACT

The low mathematical literacy is influenced by internal student factors. One that influences is the cognitive style of students. This study aims to describe students' mathematical literacy abilities with *field-independent (FI)* and *field-dependent (FD)* cognitive styles on linear program materials. This research is qualitative. The subjects of this study were class X MM & PKM students of SMK Cendekia Madiun for the 2021/2022 Academic Year, as 16 students. The data were analyzed descriptively. To group students using *GEFT* questionnaires and data collection techniques using a test for describing mathematical literacy skills and using interviews. The result of this study is that students with *a Field Independent (FI)* cognitive style master the following aspects of literacy ability: communication skills, mathematical abilities, representation abilities, reasoning and argument skills, problem-solving strategy skills, ability to use language and symbol operations, formal and technical. Meanwhile, students with *a Field Dependent (FD)* cognitive style master the following aspects of literacy: communication skills, mathematical skills, representation abilities, problem-solving strategy skills, ability to use language and symbol operations, formal and technical. This research is limited only by 2 students. In the future, it is necessary to conduct research involving more students with different materials.

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1. INTRODUCTION

Mathematics is a pattern that grows and develops in life created from thought processes that will create patterns of order, connect between concepts, and apply organized concepts in solving daily problems (Oktiningrum et al., 2016; Philosophy, 2008; Riyanto, 2017; Widodo & Wahyudin, 2018). Mathematics learning is not only an orientation to the final result, but emphasizes all activities in the ongoing teaching and learning process (Grootenboer, P & Marshman, 2015). So that students are not only able to solve problems in mathematics, but must also be able to provide material explanations with mathematical language and be able to think logically, critically, creatively, systematically, and innovatively in solving problems (Planas, 2018; Ramdhani et al., 2017; Surya & Syahputra, 2017).

Without realizing it, every daily activity, must have something to do or not be separated from mathematical concepts. In essence, mathematics learning is not only focused on counting, but also on how students can apply mathematics to solve problems that exist in life every day. According to Akbar et al. (2018) that students' ability to use mathematics or associate mathematics in everyday life can be called mathematical literacy. In line with the opinion of Utomo et al., (2020) mathematical literacy is the ability of students who focus on the use of mathematics in everyday life and not only on operations of mathematics.

Mathematica literation is very important for students to understand mathematics not only in the mastery of the material but also in the use of reasoning, concepts, facts, and mathematical tools in solving everyday problems and require students to communicate and explain the problems they face with mathematical concepts (Cameron et al., 2019; Fointuna, 2021; OECD, 2016). Abidin, Mulyati, and Hana (2018) also stated that "mathematical literacy has to do with problems that occur in the real world and is more than just recalling facts basic, using memorization algorithms as well as performing simple calculations. Mathematical literacy also involves understanding mathematical activities, the use of mathematical knowledge and abilities, reasoning, and language to solve problems in various circumstances as well as needs. Mathematical literacy is very important if you want to truly understand the information that is around us in this modern life (Susanti et al., 2023; Sholihah, 2023). If a person can't apply his mathematical knowledge to solve problems in everyday life, then he cannot be said to be literate in mathematics".

PISA states that mathematical literacy is "individual certainty in formulating, affining, and using mathematics in various contexts. This includes mathematical reasoning as well as using mathematical concepts, fact procedures, and tools to draw, explain, and predict phenomena (Susanti, 2021). It assists the individual in recognizing the role played by mathematics in life as well as assisting in the well-founded decisions and judgments that will be needed by the population that is engaged and reflective" (OECD, 2019). Furthermore, PISA stated seven aspects of the main components of students' mathematical literacy skills, namely:

Table 1. Mathematical Literacy Ability Indicators

Aspects	Indicator
Communication Skills (*communication*)	Students can understand, clarify and formulate problems
Mathematical Ability (*mathematizing*)	Students can turn the problem of the story problem into a form of a mathematical model
Representation Ability (*Representation*)	Students can translate problems into formulas, tables, and graphs so that they are easy to understand
Reasoning and Argumenting Ability	Students can analyze problems to come up with the right answers.
Devising Strategies for solving Problems	Students can choose strategies or steps in solving problems
Ability to Use Language and Symbolic Operations, Formal and *Technical Language and Operations*	Students can use symbols in mathematics to solve problems.

Ability to Use Mathematical Tools	Students can use mathematical tools to help with mathematical activities, such as calculators, rulers, and others.

The results of research conducted by Munir et al. (2019) show that the mathematical literacy skills possessed by SMK students in *problem-based learning* are still relatively low. In line with research conducted by Khoirudin et al. (2017) that students' mathematical literacy abilities are still diverse and are classified as not good or low due to many factors including the learning provided by the teacher, the readiness of students in learning, and the ability of the students themselves. This shows that student literacy is still relatively low. Based on the results of observations that researchers have made in class X MM and X PKM at SMK Cendekia Madiun, most students still have difficulty presenting problems and problems with two-variable linear inequality stories in the form of mathematical models. Of course, this can have an impact on the student's process of solving the problem at hand. This is reinforced by the results of student work during daily tests, where students are still weak in terms of mathematical literacy skills.

Many factors can affect student learning outcomes, one of which is cognitive style. According to Kozhevnikov in Akbar et al., (2018) said cognitive style is a stable attitude that can influence in using strategies and individual ways of remembering, receiving, and in solving problems. Furthermore, according to Slameto in Jazuli et al., (2022) cognitive style is an important variable that can influence student recovery in academic fields such as problems when learning, student behavior while studying, how the student learns, how students think in learning, how students process information and how students in solving problems.

Saputri's research (2018) showed that cognitive styles can affect the achievement or learning outcomes of mathematics from SMK students. This is in line with research conducted by Febriyanti, (2015), which also shows a significant influence, namely cognitive style on student learning outcomes in trigonometric lessons. Based on some of the results of the study, it is proven that the cognitive style that each individual has can affect the achievements and learning outcomes obtained by students at school. So teachers must understand students' cognitive styles to obtain maximum learning achievement.

Darmono, (2012) classifies cognitive styles into two, namely students with cognitive styles *Field Independent* (*FI*) where students tend to learn independently, prioritizing critical thinking ability and systematic and independent of others or the environment. Students with *a* cognitive *FI* style are more independent in solving problems and are not influenced by criticism and motivation from friends or teachers. And students with cognitive style *Field Dependent* (*FD*) Students with cognitive *Field Dependent* (*FD*) it is the way individual learning tends to depend on the environment and social, thinking globally (overall) so that it is easy to follow the advice and criticisms of others. Students with *an FD* cognitive style have difficulty solving problems on their own, so they need help and motivation from friends and teachers. In line with the opinion expressed by Febriyanti (2015), students who have the cognitive style *Field Dependent* usually like to learn on their own to solve problems faced, prefer to work in abstract concepts, and will determine for themselves the goals be achieved, while cognitive-style learners *Field Independent* prefer social problems, are interpersonally oriented, and prefer to work with others or groups.

Based on the explanation above, it is necessary to conduct further research on how students' mathematical literacy is displayed in the Linear Program material in terms of cognitive style. This research will also be carried out at SMK Cendekia Madiun because the school has never conducted a similar research and at SMK Cendekia Madiun has held a school literacy movement in accordance with the direction of the mayor of Madiun, but the results of the movement are not significant, especially in mathematics.

2. METHODS

The type of research used in this study is qualitative research. Moleong (2017) qualitative research is research that intends to understand phenomena about what is experienced by research subjects such as behavior, perceptions, motivations, actions and others holistically and by means of descriptions in the form of words and language, in a natural context by utilizing various natural methods. This study aims to describe students' literacy abilities in terms of cognitive style. The subjects used in this study were class X MM and PKM students of SMK Cendekia Madiun for the 2021/2022 school year, totaling 16 students.

The procedure for implementing this research consists of a preparatory stage which includes determining the place and time of research, preparing research instruments including the *GEFT (Embedded Figure Test)* test, literacy ability test mathematics, and interview guidelines, as well as instrument validation of mathematic literacy test and interview guidelines. The next stage, namely the data collection stage, includes the implementation of the *GEFT (Embedded Figure Test)* test to determine the cognitive style of each student, the implementation of a mathematical literacy test, and continued implementation of the interview. GEFT is a perceptual test modified from the Embedded Figures Test (EFT) developed by Herman. A Witkin et al. GEFT is a standard test in America, so changes to GEFT should be avoided as much as possible. Thus this tool does not need to be tested or developed (Hasbi, 2012). The GEFT test has been measured for its reliability by previous researchers. The value obtained from the reliability of Alpha Cornbach is 0.84, meaning that the reliability of GEFT is very high (Khodadady and Tafaghodi, 2013). The GEFT is valid because it is often used to measure cognitive style in previous studies.

The next stage is data validation and data analysis to conclude the mathematical literacy ability of *Field Independent (FD)* students and *Filed Dependent (FD) students.* The instruments used in this study were the researchers themselves, a test instrument that includes the *GEFT (Embedded Figure Test)* test to determine the type of cognitive style of students, and the instrument of mathematical literacy ability test which consists of two questions that have been validated by the validator. The *GEFT (Embedded Figure Test)* test consists of 25 questions and is divided into three parts, part I consists of 7 complex drawing questions as practice questions. Part II and part III each consist of 9 complex drawing questions. To classify students who have a cognitive *Field Independent* (*FI*) style that is, students who score more than 9 out of the maximum score that students can get if they answer all questions correctly. Meanwhile, the classification of students who have a cognitive field *Dependent* (*FD*) style is students who score less than or aqual 9 of the maximum score that students can get if they answer all questions correctly. The maximum score obtained if the student answers correctly is 18.

Aactivityvitas data analysis in this study consists of data reduction, data presentation, drawing conclusions, and verification (Sugiyono, 2014). In analyzing students' mathematical literacy abilities, it can be seen from the achievement of predetermined indicators.

3. FINDINGS AND DISCUSSION

Based on research that has been carried out in class X MM and PKM SMK Cendekia Madiun, *the GEFT (Embedded Figure Test)* test results are obtained as follows:

Table 2. *GEFT* Test Results

Cognitive Styles	Number of Students
Field Independent (FI)	4
Field Dependent (FD)	12

Furthermore, 2 subjects were selected, namely, 1 student with cognitive style *Field Independent* (*FI*) and 1 student with cognitive style *Filed Dependent* (*FD*). The selection of research subjects is carried out with the consideration that the student can represent each category and can provide information

regarding mathematical literacy abilities. The following is the data of students selected as research subjects.

Table 3. Research Subjects

Student Name	Shoes	Category	Information
Indah Pratiwi	11	*Field Independent* (*FI*)	Subject 1
Paramita Puspa S	9	*Field Dependent* (*FD*)	Subject 2

The following are the results of the answers to the mathematical literacy ability test in *the Field Independent (FI)* Subject:

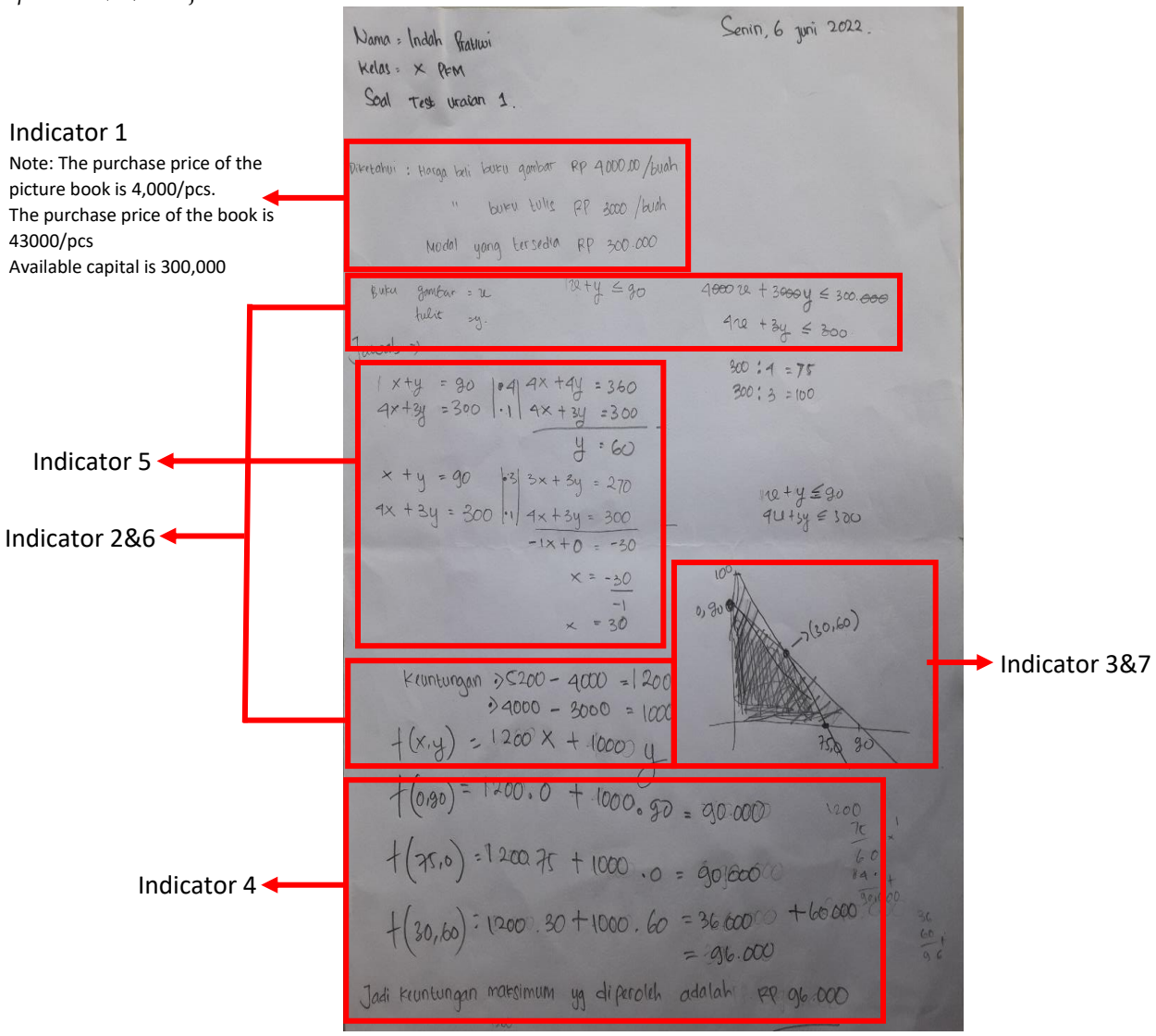

Figure 1. Subject Literacy Test Results 1 Question 1

Based on Figure 1, subject 1 can understand the problem by writing down the known but subject 1 does not write down what the question asks (Indicator 1). But during the interview, Subject 1 can mention what is known and what is asked. This is in line with the results of research by Akbar et al. (2018), that which the subject *of the Field Independent* (*FI*) did not write down the question information on the answer sheet, but when the interview, it can be named exactly. As well as in the results of

research by Jazuli et al. (2022) showed that the *Field Independent* (*FI*) student group can explain information that is known and asked questions, but below presented in writing on the answer sheet.

Furthermore, subject 1 can make excuses by providing picture books as x and writing books as y well as being able to turn problems into mathematical forms to make them easier to do, the mathematical form is $x + y \leq 90$, $4x + 3y \leq 300$, and $F(x, y) = 1200x + 1000y$, $F(x, y)$ as symbol-function purpose (Indicator 2&6). Subject 1 uses the elimination method to find the intersecting points of two equations $x + y = 90$ and $4x + 3y = 300$, that is, by eliminating the variable x first so that the value is obtained $y = 60$, then eliminating the variable y and obtaining the value $x = 30$ (Indicator 5). To obtain the right answers and conclusions subject 1 substitutes the points on the result area for the goal function $F(x, y) = 1200x + 1000y$ (Indicator 4). To make it easier to solve the problem subject 2 presents the problem in the form of a chart (Indicators 3&7). Subject 1 also shades the settlement area on the graph correctly. This is in line with Izzatin's opinion in Jazuli et al. (2022) that *Field Independent* (*FI*) students can process information, able to model problems using the visualization of images and the ability of reasoning and arguments is good to produce accurate answers. However, drawing a graph to find the area of completion of subject 1 does not use a mathematical tool in the form of a ruler so it is not yet precise in determining the period. Subject 1 gives the reason for drawing not using a ruler because it is lazy and not accustomed to and faster if it does not use a ruler. During the interview Subject 1 was able to explain the mathematical form and intent of the graph that had been drawn. Subject 1 can also analyze the problem and choose the right strategy to solve the problem.

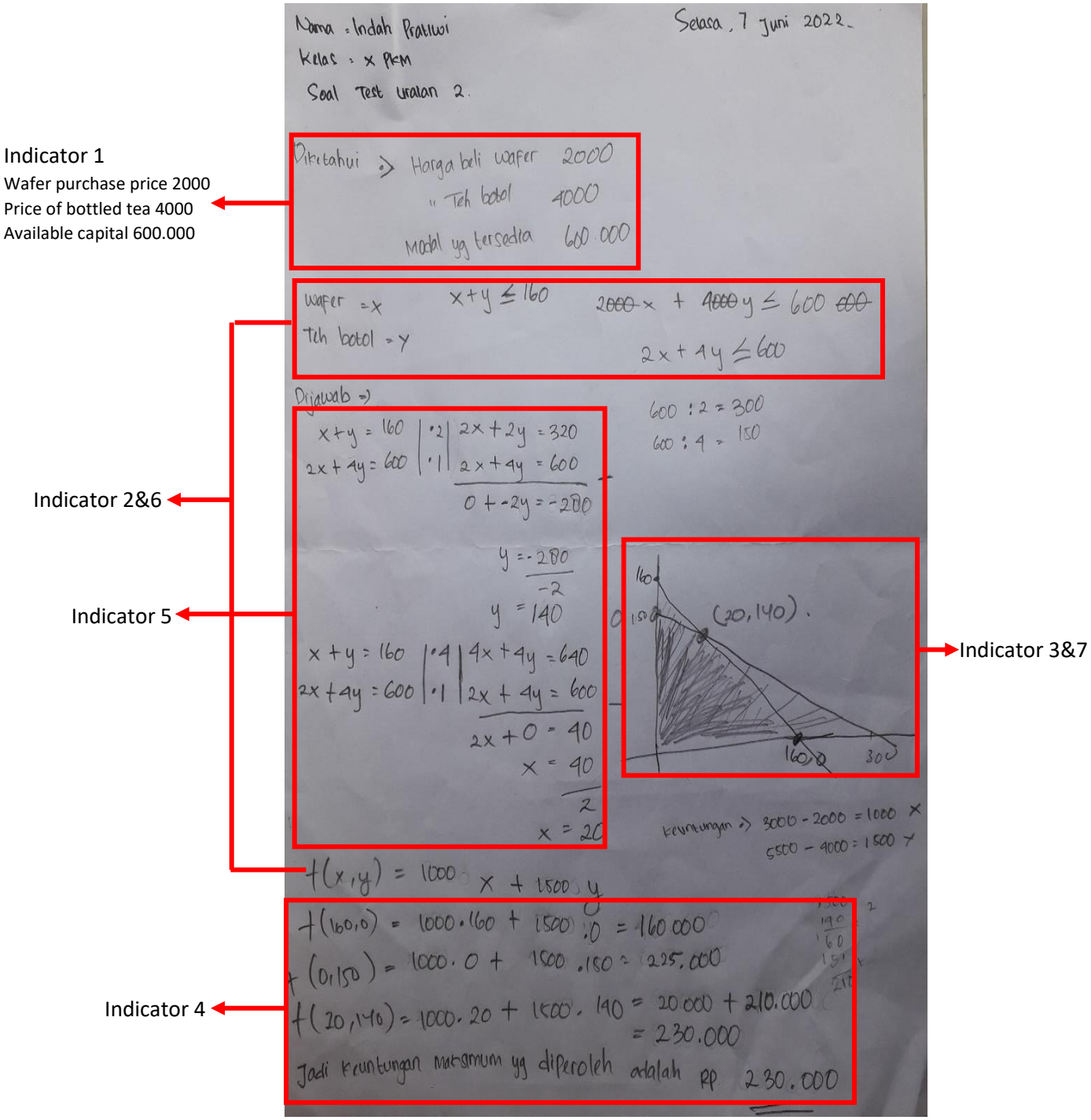

Figure 2. Subject Literacy Test Results 1 Question 2

Based on Figure 2, subject 1 can understand the problem by writing down the known but subject 1 does not write down the question (Indicator 1). Similar to the first interview, subject 1 can mention and explain what is known and asked of the question. Furthermore, subject 1 can make excuses by providing wafers as x and bottled tea *as* y well as being able to turn problems into mathematical forms to make it easier to do, the mathematical form of the fish, namely $x + y \leq 160$, $2x + 4y \leq 600$, and $F(x, y) = 1000x + 1500y$, $F(x, y)$ as a symbol of the purpose function (Indicators 2&6). Similar to the first question, in the second question Subject 1 also uses the elimination method to find the intersecting points of the two equations $x + y = 90$ and $4x + 3y = 300$, that is, by eliminating variables x first so that a value is obtained $y = 140$, then eliminating the variable y and a value is obtained $x = 20$

(Indicator 5). During the interview, the subject explained that it was the method that he thought was the easiest. The subject said that his teacher used to often explain using the combined method, but the subject preferred to use the elimination method. This is in line with the opinion of Jazuli et al., (2022) that *field-independent* (*FI*) subjects have higher courage and creativity in solving problems.

In the aspect of reasoning and argument, Subject 1 is better than subject 2, because for can get the right answers and conclusions subject 1 substitute the three dots on the result area to the goal function($F(x,y)) = 1000x + 1500y$ (Indicator 4). To make it easier to solve the problem subject 2 presents the problem in the form of a graph, but in drawing a graph to find the area of solution of subject 1 does not use mathematical tools in the form of rulers so they are not yet precise in determining points (Indicators 3&7). Subject 1 is also able to explain the graphs and mathematical forms that have been written in the answer sheet.

The following are the answer results of the mathematical literacy ability test on the Subject *field Dependent (FD):*

Communication skills are the ability to understand, clarify and formulate a problem. Based on Figure 3, subject 2 can understand the problem by writing down what is known and asked by the question (Indicator 1). During the interview Subject 2 was able to explain the meaning of the question, namely by mentioning what was asked and known. During the interview, the researcher received information that the subject could understand the linear program material if the teacher explained the material in sequence and clearly. According to Yuliyani & Setyaningsih's opinion, (2022) that the subject *of Field Dependent* (*FD*) in learning requires direction and guidance from the teacher, so the teacher must provide extra explanations so that the subject can use the ideas they have to solve the problem.

Furthermore, subject 2 can turn the problem into a mathematical form to make it easier to do, the mathematical form is $x + y \leq 90$, $20x + 15y \leq 1500$, and $F(x,y) = 1200x + 1000y$, $F(x,y)$ as a symbol of the goal function (Indicators 2&6). Although subject 2 did not write down the excuses, during the interview subject 2 was able to explain how to choose excuses. Subject 2 uses the combined method to find the intersecting points of two equations $x + y = 90$ and $20x + 15y = 1500$, that is, by eliminating the variable y first so that a value is obtained $x = 30$, further substituting the value $x = 30$ to the equation $x + y = 90$ so that a value is obtained $y = 60$ (Indicator 5).

In the aspect of reasoning and argument Subject 2 only substitutes one point in the result area for the goal function($F(x,y)) = 1000x + 1500y$ so it is not appropriate in determining the answer and subject 2 also does not write the conclusion (Indicator 4). On the answer sheet, the subject *Field dependent* (*FD*) also does not shade the settlement area in the graph image. This is in line with the opinion of Jazuli et al., (2022) that the reasoning and argument ability of *Field dependent* (*FD*) students is less profound and less careful in working on questions so that the answers obtained are not optimal. To make it easier to solve the problem subject 2 presents the problem in the form of graphs and tables, but in drawing graphs and tables Subject 2 does not use a ruler (Indicators 3&7). Subject 2 explains not using a ruler when drawing graphs and tables because subject 2 does not have a ruler.

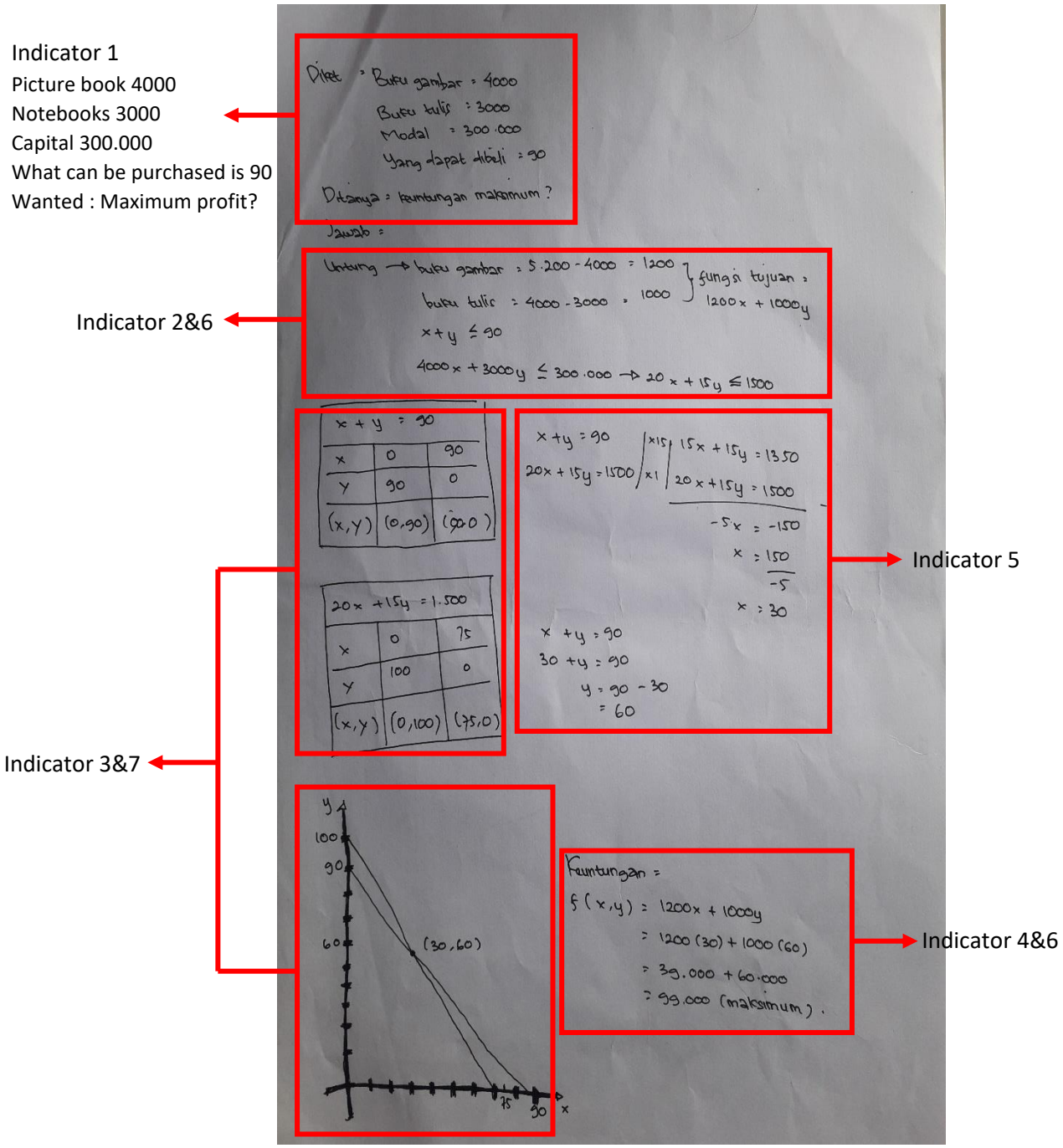

Figure 3. Subject Literacy Test Results 2 Question 1

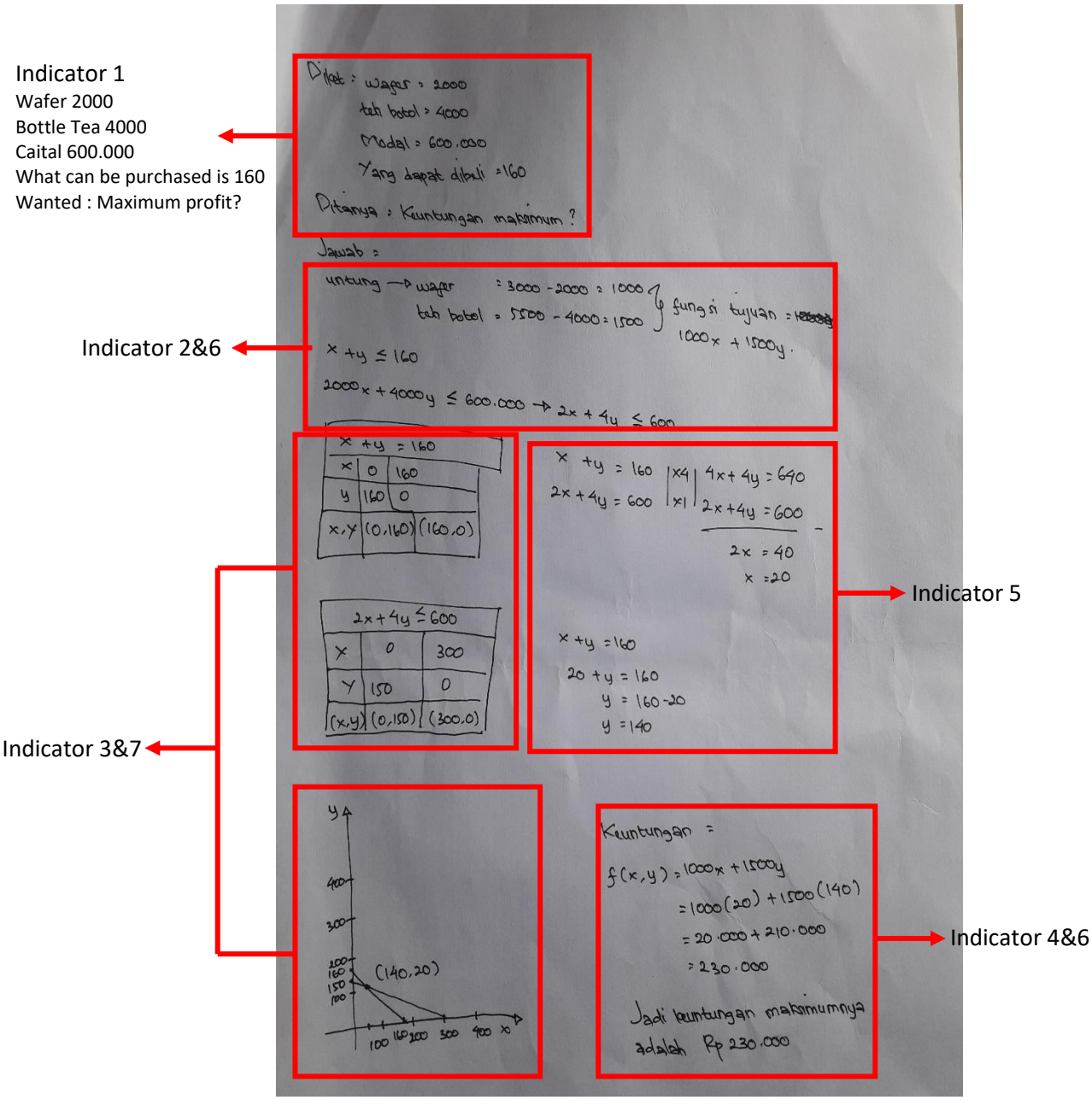

Figure 4. Subject Literacy Test Results 2 Question 2

Based on Figure 4, subject 2 can understand the problem by writing down what is known and asked by the question (Indicator 1). Furthermore, subject 2 can convert the problem into a mathematical form to make it easier to do, the mathematical form is $x + y \leq 160$, $2x + 4y \leq 600$, and $F(x, y) = 1000x + 1500y$, $F(x, y)$ as a symbol of the goal function (Indicators 2&6). Similar to the first problem, Subject 2 also uses a combined method to find the intersecting points of two equations $x + y = 160$ and $2x + 4y = 600$, that is, by eliminating variables y first so that a value is obtained $x = 20$, further substitutes the value $x = 20$ to the equation $x + y = 160$ so that a value is obtained $y = 140$ (Indicator 5). However, to get the right answer and conclusion subject 2 only substitutes one point in the result area for the goal function $F(x, y) = 1000x + 1500y$ (Indicator 4). Subject 2 chose to use a combined method of both the first question and the second question because it was judged to be easier and faster. Subject 2 said that the combined method is a method often used by the teacher. So that the subject better understands the combined method because it is often taught during learning. This is to the

opinion of Darmono, (2012) that students with *a Field Dependent (FD)* cognitive style have difficulty in solving themselves so learning requires guidance and direction from teachers.

To make it easier to solve the problem subject 2 presents the problem in the form of graphs and tables, but in drawing graphs and tables Subject 2 also does not use tools of mathematics it is a ruler (Indicators 3&7). Based on the results of the interview, subject 2 still has difficulty in the aspects of reasoning and arguments and Subject 2 has not used mathematical tools to assist in doing mathematical problems.

4. CONCLUSION

Based on the results of the discussions that this researcher has carried out, it can be concluded that students' mathematical literacy abilities in linear program materials in terms of cognitive style are 1) The aspects of mathematical literacy skills mastered by *field independent* (*FI*) students are as follows: communication skills, mathematical skills, representation skills, reasoning and argument skills, problem-solving strategy skills, ability to use language and symbol operations, formal and technical. 2) Aspects of mathematical literacy skills mastered by *field-dependent* (*FD*) students are as follows: communication skills, mathematical skills, representation skills, problem-solving strategy skills, ability to use language and symbol operations, formal and technical.

This study only took 2 subjects based on cognitive style. For subsequent research, research is needed that takes more subjects so that the research results are more accurate. In addition, it is also necessary to analyze mathematical literacy from various levels so that teachers can prepare lessons that are suitable for different levels of mathematical literacy.

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